REMARKS

Applicants would like to thank the Examiner for the thorough review of the present application. As discussed in detail below, the present claims in the present application include recitations that patentably distinguish the claimed invention over the cited references, taken individually or in combination. Based upon the amendments and the following remarks, Applicants respectfully request reconsideration of the present application and allowance of the pending claims.

The Invention

The invention provides for by providing a miniature electrical relay having a thin film piezoelectric actuating element as the primary driver. The claims to the present invention are drawn to a cantilevered relay. Such miniature relay advantages include cheap and simple fabrication, low operating power, high force output, high current switching capability, and integration with small circuits.

In one embodiment of the invention a microelectronic electric relay includes a support structure, typically a substrate, integrated circuit or the like. The support structure includes a continuous planar surface having a first portion and a second portion. The relay further includes a first contact and a second contact. The first contact is *mounted on* the first portion of the continuous planar surface and comprises an upper and lower surface with the lower surface being *adjacent* to the first portion of the continuous planar surface. The second contact is *mounted* on the second portion of the support structure and comprises an upper and lower surface. One portion of the second contact *is co- planar with respect to the first contact* (see Fig. 1) and a portion of the lower surface of the second contact is directly opposite from the upper surface of the first contact. The relay additionally includes a piezoelectric actuator deposited on the upper surface of the second contact and *fully supported by the second contact* for selectively deforming

the second contact relative to the first contact such that the lower surface of the second contact selectively engages the upper surface of the first contact.

Unlike discrete component fabrication that is not as limited in terms of device size, the MEMS relay device fabrication process benefits from using conventional semiconductor processing techniques to provide for microelectronic relay devices that can be formed on the underlying planar support structure without the need to implement additional support structures. As an example, in one fabrication process the first and second contacts are formed using conventional semiconductor processing techniques and release layer processing allows for the contacts to be separated (or the contacts to be in contact) subsequent to the removal of a release layer. The piezoelectric actuator is disposed on the second contact and fully supported by the second contact and upon actuation serves to deform the second contact such that it engages (or disengages) the underlying first contact.

Claim Rejections

35 U.S.C. 103 (a) Rejections

Ohba et al. '555 or Harnden '118

Claims 1 – 8 stand rejected under 35 U.S.C. 103 (a) as being unpatentable over either of Ohba et al. '555 or Harnden '118 patents and in view of the Komanek '010 patent, the Higgins '331 patent or the Mariani et al. '691 patent. The Examiner asserts that the Ohba '555 patent or the Harnden '118 patent teach the general structure of the relay as claimed except for explicitly teaching using a deposited piezoelectric element.

According to the Examiner the Ohba '555 patent teaches in Figure 2 a substrate (11) carrying a contact (15a) and a moveable contact (13a) with the moveable contact being connected to piezoelectric activator (1a). Similarly, the Examiner states that the Harnden '118 patent teaches in Figures 4 and 6 a moveable contact (642) deposited on a piezoelectric element (622a). The Examiner relies on the Higgins '331 patent, the Komanek '010 patent and/or the Maiani

'691 patent to argue that theses patents provide ample teaching that it is obvious to deposit piezoelectric elements to drive a moveable membrane.

The Ohba '555 patent and the Harnden '118 patent do not teach or suggest depositing the piezoelectric actuator on the second contact such that the piezoelectric element is fully supported by the second contact.

Claim 1 of the present application provides for a relay device having a piezoelectric actuator that is deposited on the second contact and fully supported by the underlying second contact. As shown in Figure 1 of the present application, the piezoelectric actuator (47) is formed of electrodes (30 and 40) and piezoelectric element (35). These actuators elements are thin films that are formed as layers on the second contact (20) and are fully supported by the second contact (20). The thin film nature of the piezoelectric actuator allows for the actuator layers to be deposited upon the second contact without imparting operation-impairing weight to the overall relay construct. Thus, the second contact is capable of fully supporting the piezoelectric actuator.

The Ohba '555 patent does not teach or suggest depositing the piezoelectric actuator on the second contact nor does it teach or suggest fully supporting the piezoelectric actuator by means of the second contact. The Ohba' 555 patent teaches a moveable contact (13a-d) that is mounted or affixed to the underside of the piezoelectric actuator (2a-d, 3a-d and 4a-d). The piezoelectric actuator is supported by "being clamped between a mounting member (10) and a top member (9), said mounting member being fixed to a base plate (11) of the relay" (column 3, lines 64-66). The discrete nature of the device in the Ohba '555 patent and, specifically, the bulkiness of the piezoelectric element, referred to in the specification as a "plate", necessitates that the piezoelectric actuator, as well as, the second contact be supported by a mounting member or other structure that would serve to position the actuator and the contact a switching distance away from the fixed contact.

In the present application, the thin film nature of the piezoelectric actuator, allows for the elements that form the actuator to be disposed directly on the second contact and *fully supported* by the second contact, without imparting such weight to the overall relay structure that it would

render the device inoperable. In other words, if the piezoelectric plates described in the Ohba' 555 patent were deposited on the second contact they would likely weigh down the cantilever such that it would be inoperable (i.e., the switch always being closed) or would require excessive voltage being applied to the piezoelectric actuator to impart deformation in the second contact.

The Harnden '118 patent does not teach or suggest depositing the piezoelectric actuator on the second contact nor does it teach or suggest fully supporting the piezoelectric actuator by means of the second contact. The Harnden ' 118 patent teaches, in Figures 4 and 6 a moveable contact (460 and 646) that is mounted or affixed to the distal end of the piezoelectric actuator (422 and 622). The piezoelectric actuator is supported by an anchor (426 or 626) that is disposed on the case surface (424a and 624a). The discrete nature of the device in the Harnden '118 patent and, specifically, the bulkiness of the piezoelectric element finger (422a and 622a), necessitates that the piezoelectric actuator be supported by a anchor or other structure that would serve to position the actuator and the contact a switching distance away from the fixed contact (444 or 644). In the Figure 4 embodiment the second contact structure, including pad (464), flexible circuit board (460) and movable contact (442) would not impart the degree of strength required to support the discrete piezoelectric actuator element (422). In the same regard, in the Figure 6 embodiment the second contact structure, including the pad (646a), the electrical conductor (646) and the moveable contact (642) would not impart the degree of strength required to support the discrete piezoelectric actuator element (622).

Therefore, the Ohba '555 patent nor the Harnden '118 patent teach or suggest depositing the piezoelectric actuator on the second contact such that the piezoelectric element is fully supported by the second contact.

The Ohba '555 patent does not teach mounting the contacts on a planar surfaced support structure.

Claim 1 of the present application requires that the first and second contacts be mounted on mutually exclusive first and second portions of a continuous planar surfaced support structure. This is shown in Figure 1 of the present application, in which, the support structure (10) has a

continuous planar surface and the first contact (15) is mounted on a first portion of the planar surface and the base (22) of the second contact (20) is mounted on a second portion of the planar surface.

The Ohba '555 patent does not teach or suggest the mounting of first and second contacts on first and second portions of a continuous planar surfaced support structure. Referring to Figures 1 and 2 of the Ohba '555 patent, the first contact (15a-d) is mounted on a planar surface of the base plate (11). However, *the second contact (13a-d) is mounted on a piezoelectric plate (4a-d) and the piezoelectric plate is mounted on mounting member (10)* which serves to elevate the bimorph structure and associated contact above the base plate (11). The second contact (13a-d) in the Ohba '555 patent is not taught such that it is mounted on the base plate (11) nor is there any suggestion that it could be mounted on the base plate. Even if one assumes that the base plate 11 and the mounting member form the support structure, it *cannot be asserted that the contacts are mounted on a continuous planar surfac*e of the support structure. The discrete nature of the device taught in the Ohba' 555 patent and the rigid cantilevered bimorph structure (1a-d, 2a-d, 4a-d) would require the second contacted to be mounted on the cantilever, which is positioned above the surface of the base plate.

Therefore, the Ohba '555 patent does not teach or suggest mounting the first and second contacts on separate portions of a continuous planar surface of a support structure.

The Ohba '555 patent does not teach a portion of the second contact being co-planar planar with respect to the first contact.

Claim 1 of the present application requires that a portion of the second contact be co-planar with respect to the first contact. Figure 1 of the present application illustrates this claim requirement, in that, a portion of the second contact (20), the base (22), is disposed in a first plane (i.e., the portion that is disposed in a vertical plane adjacent to the support structure) and the first contact (15) is disposed in the same first plane.

The Ohba '555 patent does not teach or suggest a portion of the second contact being co-planar with respect to the first contact. In the Ohba '555 patent, the first fixed contact (15a-d) is

disposed in a first plane and the second moveable contact (13a-d) is disposed above the fixed contact in a second plane. Even if one argues that the first and second contacts are disposed in the same horizontal plane, it cannot be asserted that a portion of the second contact lies in the same horizontal plane as the first contact because the second contact, in its entirety, lies in the same horizontal plane as the first contact. A "portion of the second contact" is customarily defined as a portion less than the entirety.

Therefore, the Ohba '555 patent does not teach or suggest a portion of the second contact being co-planar with respect to the first contact.

Conclusion

In view of the proposed amended claims and the remarks submitted above, it is respectfully submitted that the present claims are in condition for immediate allowance. It is therefore respectfully requested that a Notice of Allowance be issued. The Examiner is encouraged to contact Applicant's undersigned attorney to resolve any remaining issues in order to expedite examination of the present invention.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,

James C. Edwards
Registration No. 44,667

Customer No. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

"Express Mail" mailing label number EL 910634166 US
Date of Deposit November 20, 2002

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Commissioner For Patents, Washington, DC 20231.

Sarah B. Simmons
CLT01/4563631v1

Version With Markings to Show Changes Made:

In the Claims:

Please amend claim 1 as follows:

1. (Twice Amended) A microelectronic relay comprising:

a support structure, wherein the support structure includes a continuous planar section having a first portion and a second portion;

a first contact mounted on the first portion of the support structure, wherein the first contact comprises an upper surface and a lower surface, and wherein the lower surface is adjacent the first portion of the support structure; [and]

a second contact mounted on the second portion of the support structure and comprising an upper surface and a lower surface, wherein a [at least one] portion of the second contact is co-planar [planar] with respect to the first contact, and wherein at least a portion of the lower surface of the second contact is directly opposite from the upper surface of the first contact, and

[wherein] a piezoelectric actuator [is] deposited on the upper surface of the second contact and fully supported by the second contact, wherein the piezoelectric actuator [for] selectively deforms [deforming] the second contact relative to the first contact such that the lower surface of the second contact selectively engages the upper surface of the first contact.